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PREFACE TO INTERBEHAVIORAL PSYCHOLOGY

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PREFACE TO INTERBEHAVIORAL PSYCHOLOGY

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When the writer first planned the present work[1] some two decades ago, his intention was to indicate how psychology could approximate the status of a natural science. The basic need at that time seemed to be (1) the isolation and accurate investigation of distinctly psychological phenomena with (2) an appreciable freedom from the general cultural and specific traditions which had always hampered psychological progress. This need the writer regarded as satisfied by the organismic (interbehavioral) hypothesis.

A glance over the past twenty years reveals a gratifying development of psychology toward its natural science goal. Recent changes in the attitudes and interests of psychologists and the accumulation of many important facts make possible a gradual, if slow, departure from traditional dualism and an approach toward an organismic or interbehavioral[2] psychological position.

Scientific achievement is directly proportional to the scientist's departure from problems concerning general existence or reality and his approach toward an investigation of specific happenings. This principle applies to psychology equally with all the other sciences. Accordingly, psychologists may turn squarely away from the opinion held by the father of experimental psychology[3]—that "psychology is an em-

[1] This article was originally prepared as a preface for a projected reissue of my Principles of Psychology which have been out of print for some years. Because of the present unsettled condition of the learned world it seems hardly likely that this reissue will be feasible for some time to come. Accordingly, I am modifying the material of the preface into article form with the purpose of indicating some sharpening of construction and refinement of exposition which I should like to introduce into the Principles.

[2] Since the original publication of this work, the term *organismic*, which I used to characterize its viewpoint, has been employed to mark a position not in accord with mine. In consequence, though I do not for this reason altogether abandon the term, which I first introduced into psychology in an article on *Emotions* in 1921 (*Psych. Rev.*, vol. 28, nos. 1 & 2), I am very partial toward the term *interbehavioral* to distinguish the hypothesis of the present treatise.

[3] Cf. Wundt, W., Outlines of Psychology, Leipzig, Engelmann, 1907, p. 6.

pirical science which deals not with a limited group of specific contents of experience, but with the immediate contents of all experience"—and instead occupy themselves exclusively with the investigation of the activities of organisms. This change of attitude is reflected in the increasing shift of interest away from sensation studies to those of conditioning and learning. Historically considered, sensation problems arose out of the psychologist's concern with the psychic structure of the universe, whereas learning problems indicate an interest in the way psychological organisms interbehave with their surroundings. Now there is no reason why studies on color, sound, and other quality discrimination should not be conducted by observing the interbehavior of organisms with things. But even when psychologists and physiologists shift toward this view, their hypotheses and interpretations plainly indicate that in this type of work venerable traditions still hold sway.

The tremendous number of experiments on animal conditioning, the intensive interest in learning, and the accurate record of child development all reveal a laudable scientific faith in specific psychological events. This faith is still better indicated by the employment of exact quantitative techniques for ascertaining the functional relations between animal behavior and topography, temperature, light, mechanical and chemical conditions, etc.

We do not mean to imply that these assiduous pursuits are all free from entangling assumptions. Unfortunately most interpretations of the findings on animal conditioning and learning are still influenced by traditional views concerning the primacy of the cerebral and other physiological factors. As a consequence, physiological findings—for example, correlations of the intensities of excitatory agents with excitation processes—are substituted for perceiving events which are entirely different in character. Despite the validity of such physiological data there is the serious danger here of unwittingly adopting the view that an accumulation of physiological facts will organize themselves into a significant psychological structure.

Again there is the belief that it is better to obtain quantitative data of whatever sort rather than find out all one can concerning an important event.[4] Psychologists perhaps more than other scientists frequently forget that it is easier to make measurements than to know

[4] Cf., Johnson, H. M., Some follies of *emancipated* psychology, *Psychol. Rev.* 1932, 39, 293-323; Carr, H. A., The quest for constants, *ibid*, 1933, 40, 514-532, and The search for certainty, *ibid*, 1937, 44, 274-296.

exactly what one is measuring. Our point, then, is not that the investigation of the behavior of organisms necessarily results in an adequate science, but rather that the momentum of data properly controlled can be directed toward such an end. For this reason we deem it still desirable to stress the interbehavioral hypothesis.

Interbehavioral Psychology and Current Science—Interbehavioral psychology, we believe, is in full accord with the present reorientation of science. This reorientation increasingly insists upon specificity of observation and interpretation, and emphasizes the place of the observer in an investigation. These newer scientific trends are well illustrated by (1) relativity theory, which teaches that observations and measurements depend upon a particular space-time reference frame instead of general absolute coordinates, (2) quantum mechanics, which allows for, if not based upon, the complementarity of phenomena, such that light under certain circumstances must be treated as a stream of corpuscles and under others as a train of waves, (3) the indeterminacy principle, which instructs us that the methods, instruments, and results of an investigation are inevitably bound up with the factors comprising a given event, so that in a given case only one or two factors—say, velocity or position—can be known, and (4) the Kant-Bridgman discrimination against meaningless questions, the consequence of which is that only such problems are considered valid as can be solved by observation and experiment—in short, concrete operations of the scientist. To these must be added (5) an equally cogent consideration—namely, scientific success is a definite function of the freedom from conventional bias with which the scientist approaches his field of operation.[5] The last point does not, of course, imply that facts force themselves upon us independently of our hypotheses, instruments, and techniques, but rather that in specific situations we must ascertain whether we derive our results on the basis of conventional scientific prejudices or from our operations upon the crude data that set our problems for us. For example, when we test two individuals who consistently differ widely in their scores, are we discovering innate psychic powers or variations in brain structure or function, or are we obtaining an indication of a large number of functional relationships between an organism and all sorts of inter-

[5] Cf., Kantor, J. R., The operational principle in the physical and psychological sciences, *Psychol. Rev.*, 1938, 2, 1-32.

acting conditions? Freedom from scientific bias means freedom to choose between as many available alternatives as possible.

Since interbehavioral psychology is committed to the principle that the subject-matter of psychology is the interbehavior of organisms and objects under specific developmental and immediate conditions, it is directly in line with current scientific trends.[6] Interbehavioral psychology assumes that psychological science consists of the interbehavior of the investigator with the interbehavior of the observed organisms and their stimulational objects. Above all, such a view avoids all sorts of forces and powers assumed to bring about certain conditions. Described happenings are not only regarded as functional relationships of the components of a situation, but also depend upon the instruments and operations of the investigator.

Postulates for Psychological Science—Current scientific reorientation demands that all investigation and systematization be based upon definite and deliberate postulates. The following set of postulates which definitely formulate the interbehavioral principles contained in the present work are designed to summarize the main problems peculiar to present day psychological science.

(1) Psychology is homogeneous with other sciences.

All sciences constitute investigative enterprises for the purpose of ascertaining the nature of specific events. Such events as come to the notice of scientists are reducible to things, their behavior, conditions and relations as these are analyzed out of the complex events. It is assumed that nature comprises an intricate manifold of events—fields in which things (particles, waves, organisms, etc.) operate in certain ways and change under certain specific conditions. Each science including psychology isolates some phase of this manifold for its special object of study. The data and methods of psychology are therefore homogeneous with those of all other sciences. Since scientific investigations and techniques vary with the kind of subject-matter operated upon, so psychological techniques of observation are in part similar to and in part different from those of other specific sciences. It is assumed here that all sciences are coordinate, none

[6] As the writer has indicated in the former Preface (p. xvi) it is this notion of the interbehavior of factors in a situation or system that differentiates the Galilean—that is, the modern scientific departure—from the Aristotleian doctrine of internal causes or principles.

being more basic than any other. Whatever hierarchy of sciences one may set up can only be based upon quantity of achievement. All are natural and each is as fundamental as any other.

(2) Psychology is a relatively independent science.

Although the fact that all sciences draw upon the same manifold of things and events implies that there is an interrelationship between all sciences, it is still true that they may be relatively independent of each other. Psychology having its own subject matter and accumulation of facts and principles cannot therefore borrow abstractions from any other science as its data. Whatever similarities there may be between psychology, physics, and biology result from a similarity in objects dealt with and techniques of study. Psychology, then, does not require any specific neural or general biological guarantee for the reality of its data.

(3) Psychology is interrelated with the social as well as biological and physical sciences.

Since all sciences operate in a common field of natural phenomena it is inevitable that their data should overlap. Especially is this the case with psychology which studies events involving all sorts of physical, chemical and biological conditions. While the cooperation of the psychologist with the physicist and biologist in solving problems involving the responses of organisms to stimuli has always been recognized, the importance of social or cultural conditions influencing the origin and operation of psychological interbehavior remains still to be adequately appreciated.

The import of this postulate may be readily discerned by glancing at the prevailing present day ideas of psychologists with reference, for example, to the process of perception. In this field of psychological work there is an admirable orientation in and use of data from physics and biology. The result, however, is not so salutary. Descriptions of visual interbehavior with objects, for instance, certainly are reduced to effects of radiation on organic parts without regard to the actual character and properties of things.

In perceiving a common red brick psychologists assume that the individual is a neurobiological mechanism, whereas the brick is simply an absorber and reflector of light rays. Actually, the scientific constructions in psychology must be made against a background of cul-

tural development and present circumstances of the individual and the object. How a brick is perceived, what it means to the individual, how he reacts to it, are functions of cultural as well as organic and physico-chemical events. So far as the brick is concerned it is just as much a factor in a cultural system as in a system of chemistry and physics. While the chemist and physicist may neglect its cultural properties, the psychologist can not do so.

It is no satisfactory justification to say that the neglect of the cultural features of events (1) brings psychological descriptions to the abstract and analytic level and (2) articulates psychology with physics and biology. In the first place, this view implies that constructions are ends in themselves and not simply tools for the orientation of the scientist to events. Again, there is the implication that psychological events need to be reduced to the events of other sciences. This latter point does not allow for the autonomy and worth of psychological events. And finally there is erroneously implied that the processes followed by physics and biology to obtain valid constructions are not available to students of cultural events.

(4) Crude data and constructions are continuous.

Since all science consists of the development of descriptive and interpretative constructions, there must be a continuity between such constructions and the original events constituting the crude or pre-analytic data. This means essentially that all constructions must be made upon the basis of investigative contacts of the scientist with the events which originally stimulate the interest in and work upon the problem. Thus, while constructions are different from the original data and are influenced by the instruments and hypotheses of the investigator, they are neither arbitrary nor simply impositions upon the events through the influence of traditions.

In describing or interpreting an event the worker cannot incorporate in his construction any factor not derived from an original operation upon data. For example, when a psychologist observes an organism discriminate a red from a green square, he cannot regard the color quality as a psychic or neural middle term between the stimulation—regarded as operation of light rays—and the response—considered as the operation of muscular processes. Such constructions are clearly influenced by historical traditions rather than by the investigative operations of science.

This postulate is designed to emphasize further that constructions should not only be derived from and made applicable to original events, but also that whenever it is necessary to build upon prior constructions such building must be carefully controlled. What is decidedly to be avoided is confusing the fact that the scientist constructs abstractions, descriptions, laws, etc., concerning events with the belief that the events themselves are constructs. True it is that interbehavior with events is conditioned by various prior interbehaviors, so that the events are approached with varying degrees of prior endowment, but this is no obstructing bar to carrying on investigations of the prepatinated events. An excellent psychological illustration of what must be guarded against is building psychological constructions out of prior biological (muscle action) and physical (energy) constructions as though these were preanalytic investigative events.

(5) Interbehavior is the essential datum of psychology.

The specific events which psychology investigates consist of the interactions of organisms with objects, events or other organisms and their specific qualities, properties, and relations. These interbehaviors, whether movements toward or away from things, manipulations of all sorts, speaking of them, or reflecting upon them are all concrete actions based upon observable events and in no sense manifestations of any occult powers or forces. Furthermore, none of the objects or their properties are psychic creations or projections of organisms or individuals. When the individual imagines or invents something, this also is an interbehavior—an interbehavior in this instance with substitute stimulus objects. Similarly, when the individual interbehaves with an object not on the basis of its natural properties, but on the basis of attributed properties, as in social psychological situations, we have a definite interbehavioral situation. In other words, we have stimulus and response functions in a specific locus or field. When in any given instance we are unable to observe the details of the interbehavior, we can only assume, as in the case of every other science, that this incapacity is owing to nothing more than the intricacy of the phenomena or the ineffectiveness of our techniques.

(6) Psychological interbehavior comprises unique details.

While all natural phenomena consist of interbehavior of various sorts, the specific details of such interbehavior vary considerably.

Physical as compared with psychological interbehavior is commutative. The contacts of two physical objects (billiard ball impacts) can be described as a mathematically equivalent interchange of energies. In more complicated phenomena such as hysteresis in a magnetic field a similar interrelation obtains. Although the inductive behavior of a piece of iron varies on the basis of its previous history, so that, on the one hand, when it is completely unmagnetized it requires a higher magnetizing field strength to induce a given magnetization than if it had been previously magnetized, and, on the other, requires a coercive field strength in addition to the reversal of the original field to reduce its magnetic intensity to zero, the energy used up in alternately magnetizing and demagnetizing the iron is equivalent to the quantity of heat that appears in it. The whole phenomenon can after all be interpreted as the comparatively simple molecular rearrangement of the substances.

Because the biological organism is itself a complex of interrelated members with many energy interchanges of all sorts, the way an organism interacts with an object varies greatly from that of the interbehavior of two physical objects. The biological organism responds to a stimulus. The organismic system can store up energy and expend it in larger quantities and in forms which vary both from the stored up energy and the energy expended upon it. Again, since every organism is constructed on a complex plan of relatively variable and invariable structures, its movements and other performances are not only extremely intricate, but also significant from the standpoint of its environment. Hence an E = E formula can hardly represent biological phenomena.

Since biological interbehavior is definitely conditioned by the structural organization of the individual the biological responses of organisms are specific and constant and may be described as physiological functions of anatomical structures. All the essentially biological events constitute changes for the maintenance of the individual throughout the variations and changes in its environment. Such responses may be symbolized by R←S which indicates that the organism is not inert, but sensitive to its surroundings and can be put into action by their stimulating influences.

Psychological organisms are at the same time biological organisms and physical objects. Hence their behavior comprises both physiological and physical processes. But while it is true that physical and

physiological events participate in every psychological event, psychological interbehavior is not limited by the former. Naturally there is wide variation between psychological events. While the activities of the simpler organisms closely approach biological action, the interbehavior of human organisms is not strictly determined by the individual's biological organization or the natural properties of objects. Although all normal human organisms from a psychological standpoint are biologically equivalent, their activities vary widely according to their specific cultures. Psychological interbehavior may be symbolized as R⟷S to indicate that it is definitely spontaneous on the basis of previous interactions. Such interbehavior is explorative, manipulative, and orientative leading to the complex discriminating, knowing, liking, and choosing performances of human organisms.

(7) Psychological science is correlated with organismic biology.

By contrast with the classical view that psychological (psychic) phenomena are processes correlated with particular organs (localization of function, etc.), interbehavioral psychology assumes that only the activities of the total organism participate in psychological events. Specifically this means that no organ is primary or in control of any other organ. Interbehavioral psychology does not attribute any greater importance to any one structure, whether it be a cerebral or glandular organ or a biological system, than to any other.

(8) Psychological phenomena are ontogenetic.

A unique characteristic of specific psychological events is that they originate in the lifetime of particular individuals. Psychological phenomena evolve during the course of the interbehavior of the organism with specific stimulus objects. The particular ways in which individuals and their stimulus objects operate in given events depend upon the way they have previously interacted under definite conditions or auspices. This evolution of mentality may be regarded as a third stage following upon the organism's phylogenetic and ontogenetic biological developments.[7]

Historical Orientation of Psychology—Among the most effective safeguards of scientific principles is the ascertainment of the influence

[7] Cf., Kantor, J. R., The evolution of mind, *Psychol. Rev.*, 1935, 52, 455-565.

exerted by the general cultural background upon the investigator's techniques and ideological orientation. It is this cultural background which contributes so greatly to the rate and quality of scientific development. As this cultural background is constantly evolving, scientists must be sensitive to the historical development of their assumptions as well as to their special investigative techniques. A critical reading of psychological history indicates how much more the science is influenced by traditional conceptions than by what investigators actually discover when they operate upon the manifold of natural events. At the present time those psychologists who most frequently invoke the name of science are as a rule the most bound by the traditional dualism established in the 17th century.

It is a scientific paradox that though physicists and chemists have been vigorously extending their domain over the concrete properties of things, psychologists still lag behind in regarding such properties as secondary or unreal. Physical scientists have long ceased to think of length and weight as the only real properties of things and have extended their investigations over hardness, temperature, density, viscosity, compressibility and even color and sound. Psychologists, however, still believe it necessary to explain how color and sounds, for example, can exist. They still assume that colors and sounds do not exist until the brain operates. We quote a typical statement of the current psychological view.

> When we say we hear, we mean, usually that we experience sensations which have been produced by the excitation of the auditory mechanism. These elementary experiences, by means of which we are aware of so much with regard to the external world, through which we can receive the thoughts of others, and which contribute so largely to our aesthetic enjoyment of life through poetry and music, are called sounds. Yet such sounds have no objective existence; outside ourselves all is quietness. Externally there are simply bodies in vibration.[8]

The classic psychological description of sensing or perceiving implies that some form of radiation or other abstractly conceived physical condition produces an effect upon certain end-organs, conduction sys-

[8] A Handbook of General Experimental Psychology, Worcester, Mass., Clark Univ. Press, 1934, p. 880.

tem, and brain, and only after the cerebral terminals have operated does color, sound, or other sensation quality exist. Why should the existence of color or sound be a brain problem? Especially, since at once the brain is made into something other than a conducting and coordinating mechanism. Today we can well accept the notion that the psychologist is not obliged to concern himself with the existence of secondary qualities, but only with the interbehavior of the individual with colored or sounding objects. Physicists and chemists can tell us the nature and changes of color and sound properties. Here is an admirable illustration of the fact that although scientists pride themselves upon being investigators of nature, they often simply impose historical ideas upon nature.

We can only conclude that psychologists continue a tradition begun when physical scientists such as Kepler, Galileo, Boyle, Newton, etc.; found it expedient to relegate the "qualitative" aspects of nature to subjective unreality, while only phenomena capable of geometric formulation were considered objectively real. Today we know that all qualitative aspects of phenomena are equally objective and that no special virtue resides in numbers unless they symbolize quantitative results of relevant observation and measurement. Modern science has made great strides away from cosmic substance and absolute motion toward the intricate and detailed investigation of the interbehavior of specific things.

Although all the work in the laboratory on sensory discrimination, reaction time, and feelings clearly consisted of observing responses of individuals to various forms of stimulation, the establishment of experimental laboratories was not in itself sufficient to put psychology upon a natural science basis. On the contrary, as the whole Fechnerian tradition exemplifies, the laboratory served as an instrument for establishing conventional dualistic thought as over against the claims of specific facts. Thus Fechner translated Weber's results concerning the variation of response with variation of stimulation into a presumed quantitative correlation of the physical or physiological and the mental. Ever since that time experimentalists have been assuming that they were studying correlations of mental and physiological states. The power of this tendency is excellently illustrated by the conventional process of interpreting the loss or injury of a biological structure necessary for participating in, say, a visual discrimination, as the deficiency of a mediator for a psychic quality.

Clearly, however, to state what organic injuries or imperfections interfere with the organism's interaction with colored or sounding objects is not the same thing as identifying the mechanisms which make or mediate the color or sound. So persistent is traditional dualism that now when the psychic is less acceptable than it has been, theorists resort to the dodge that sensations are fruitful hypotheses and that perhaps after all they will turn out to be physiological processes. And so the entire history of modern psychology exhibits a series of variant dualistic views, first established in the Hellenistic age when Oriental thinking produced a sharp impact upon European thought.

Recent Investigative Supports for the Interbehavioral Hypothesis—It is a curious item of scientific research that usually only previously held conceptions concerning investigative details are undermined, while fundamental issues are very rarely disturbed. In psychology, for example, the accumulation of research findings in many fields might well incline the balance toward an interbehavioral and away from the conventional dualistic way of thinking, though such is not the case. The perceptual field especially offers a striking example. Despite the complexity of such phenomena as the perceiving of a multi-colored parrot or a bouquet of varied flowers, psychologists persist in analyzing them into the component physiological processes of stimulation, reception, conduction, and cerebral mediation or conversion. The net results can only be the reduction on the one hand of complex phenomena to a series of isolated abstractions and on the other adding dualistic interpretation. To indicate the trend of recent investigations of the processes just enumerated will serve to typify the support which the interbehavioral hypothesis sustains not only in the perceptual but in other fields as well.

(1) *Stimulation*—The psychologist's persistence in the view that *objects* are not *experienced,* but are constructs or inferences from the data of experience (sensations = elementary qualities) coincides with his belief that the qualities are aroused in the mind when the anatomical structures (receptors, conducting fibres, brain terminals) are made to operate upon stimulation by physical conditions. This belief also implies that there are specific forms of physical events—light rays, air waves, heat waves, etc.—correlated with specific sensation qualities. This specificity is presumed to extend to the particular qualities of given sense avenues.

Confining ourselves to color phenomena we must agree that to a certain extent spectral colors can be matched with wave frequencies; still, the following considerations concerning the lack of specificity of color stimuli prevent our ready acceptance of the putative series of dualistic events.

(a) There are no such phenomena as monochromatic light. Hence the particular correlation of wave length and sensation qualities is not an observable fact. (b) Any color (hue) that can be matched with a particular dominant wave length and its local range can be matched with some other combination. For example, orange can not only be correlated with a dominant wave length localized at a certain point in the visible spectrum, but also by a combination of dominant lengths located at the right and left of the point. (c) Red, which all agree is a primary hue, has no single dominant wave length. The absence of purples from the spectrum has provoked the issue of either giving them up as observed simple qualities or discarding the notion of specificity of light stimulation. (d) Complementary color phenomena indicate that certain wave length combinations cannot be correlated with hues at all, but with gray. (e) In general, any simple color—say, green (grass)—is derived from reflected light consisting of many wave lengths. (f) Color stimulation involves energy, time, object, size, background, and other factors as well as wave lengths.

Doubtless, all students of color agree with Mueller and Helmholtz[9] that we cannot expect to find any coincidence of sensations of color with qualities of light. These sensations, they believe, depend primarily upon the effect of light upon the physiological operations of the organic structures. Color stimuli are therefore said to be the effect of light on the retina. But the latter view is beset with insuperable difficulties. As we shall see, though the different structuralization of receptors presumably subserves different sensory functions, the receptoral processes are only the beginnings of the physiological processes. It is assumed that the physiological mechanisms are not complete until the cortex operates. Unfortunately for the presumed effects in the receptors the conductive processes in the sensory pathway are qualitatively all the same, not only for the same sense avenues, but for differ-

[9] Mueller, J., Handbuch der Physiologie des Menschen, Coblenz, 1834-40, and Helmholtz, H. L. F. von, Treatise on Psychological Optics, Rochester, The Optical Society of America, 1924-25, *et passim*.

ent ones. The brain mechanisms must then be the organic correlates or mediators of color and other qualities.

Fatal to such a view is the fact that there is much less information concerning possible correlation of physiological function and sensory qualities in the brain than in any part of the system. In consequence, all the many meticulously accumulated facts concerning visual responses appear as scientific *obiter dicta* from the standpoint of explaining visual perceiving. These data can all be handled much better as interbehavioral phenomena. Light and other conventional stimulations can be adequately treated as media of interaction between the organism, and, for example, colored or sounding objects.[10]

(2) *Receptor Action*—Despite the tremendous traditional structure of psychological science erected upon the presumed operations of end-organs, there is a surprising but inevitable outspokenness concerning the lack of specificity in their functioning. For example, as to the cutaneous receptor Nafe declares:

> After fifty years of investigation we have no demonstrated correlation between any particular type of sensitivity and the specialized end-organs and fibres that subserve it.[11]

Although investigators do regard the visual and auditory receptors as specific for visual and auditory qualities this specificity is dissipated in view of Graham's statement that:

> The discussion has given abundant evidence to show that the visual response is not a direct representation of the excitation in the end-organ or afferent pathways. Trains of impulses which reach the central nervous system by way of the peripheral nerve fibers are modified by and combined with impulses from similar and dissimilar end-organs.[12]

The writer has elsewhere[13] more elaborately surveyed the facts concerning receptors and other physiological mechanisms. Here we merely suggest the weighty implication that even when no stimulation is

[10] Cf., p. 54 f., of the present work.

[11] Handbook of General Experimental Psychology, Worcester, Clark Univ. Press, 1934, p. 1041.

[12] *Ibid*, p. 874.

[13] The nature of psychology as a natural science, *Acta Psychol.*, 1938, 4, 1-61.

applied to a receptor, electrical activity is exhibited in the cortex, which is generally regarded as the terminal of the activities set up in receptors.[14]

(3) *Conduction*—Physiological investigations have not revealed any qualitative differences in the neural impulses, so that as the evidence now stands, if one could successfully interchange the optic and auditory nerves we should still see the lightning and hear the thunder. Functional similarity obtains not only between different sensory nerves, but also between sensory and motor impulses. Even such differences as are found—rate of discharge, for instance—depend upon the diameter of the conducting fiber. Such physiological findings might stimulate the psychologist to a far-reaching revision of his conceptions, but the power of traditional thought must be reckoned with and the only result is to endow the brain with magical powers. Specifically the brain is presumed to do everything necessary to make plausible the correspondence between putative qualities of consciousness and neural functioning.

(4) *Brain Mechanism*—The unfettered observer of the scientific scene can clearly discern many striking evidences that should lead to a revaluation of our ideas concerning the operation of the brain in psychological events. Recent animal extirpation experiments and human clinical findings not only set aside the older ideas of localization of function, but further make questionable all the traditional lore concerning neural functioning in psychological performances. Dandy writes concerning two patients who survived the removal of the right cerebral hemispheres for 6 and 26 months, respectively.

> Both patients were always perfectly oriented. . . . Their memory for immediate and remote events was unimpaired. They could read, write and compute without error. . . . Both patients were always coherent; at no time were there abnormal fears, delusions, hallucinations, confabulations, expansive ideas or obsessions. Neither was there undue melancholy nor euphoria.[15]

He also declares that the removal of the left frontal lobe, the left occipital and the left temporal lobe has no effect upon consciousness.

[14] Cf., Gerard, R. W., Brain Waves, *Scientific Monthly*, 1937, 44, 48-56.

[15] Dandy, W. E., Physiological studies following extirpation of the right cerebral hemisphere in man, *Bull. Johns Hopkins Hosp.*, 1933, 53, 31-51.

Only if the left cerebral artery is injured does the patient fail to regain consciousness.[16]

Alford[17] goes even further. On the basis of some of his own cases he is certain that Dandy is wrong in his estimate of the effects of the ligation of the left cerebral artery. His own conclusion is that the place where mental functions are subserved is not the cortex but a quite small area lying posteriorly near the base of the brain on the left side. Though Alford simply varies the cerebral formula and maintains the notion of mental functions his findings suggest the need for a reconsideration of the place of brain mechanisms in psychological events.[18]

It is only natural that physiologists and other students of cortical and other neural phenomena should deny that they are merely seeking correlations between physiological and psychic processes, and insist rather that they are investigating how the organism sees, hears, etc.—in other words, what the physiological processes do in such situations. But here the question arises: Is seeing or hearing a physiological process? As the writer has so often pointed out, the facts indicate that while physiological processes inevitably participate in all psychological performances, it is only the dominance of traditional conceptions which makes us accept the proposition that physiological processes create or mediate psychic qualities and make it read that seeing or hearing is physiological.

We possess an abundance of data to indicate that the neural functions of the cortex are conductive, integrative, and coordinative—that is, biological activities. As such they have a definite place in all psychological events. It is inevitable then that injuries to the organism should constitute interferences in the performance of psychological actions. Let us keep in mind that the only basis for any belief that the brain sees or hears is the fact that cortical destruction precludes the organism from performing certain actions. The loss of the lateral portion of the striate area prevents the rat from performing detailed

[16] Dandy, W. E., The Brain, in Lewis (ed) *Practice of Surgery*, 1933, vol. 12, ch. 1 (rev.), Hagerstown, Md., W. F. Prior Co.

[17] Alford, L. B., Defects of intelligence from lesions within the central part of the left cerebral hemisphere. *Amer. J. Psychiat.*, 1937, 94, 615-638.

[18] For a more comprehensive discussion of the neural problem, see Kantor, J. R., Current trends in psychological theory, *Psychol. Bull.*, 1941, 1. 29-65.

visual responses,[19] while the extirpation of the occipital lobes in the dog precludes object vision.[20] We may regard these facts as established, but note that such facts do not establish that physiological action produces patterns or objects. They only demonstrate that a certain intactness of the organism is a necessary condition for interbehaving in a particular way with objects. It is no wise surprising that the amount and type of mutilation should correlate with behavioral interferences. Though the destruction of the cortex of animals does not interfere radically with brightness discrimination we should not expect the absence of the cortex to make *no* difference at all in the performance facility when reacting to brightness variations. It is directly in line with an interbehavioral conception that a more fundamental disturbance of the animal's organization, such as subcortical destruction, should incapacitate the organism for brightness discrimination. Of the highest importance it is to compare the results of neural destruction with the mutilation of other organs and their functions—for example, the circulatory and secretory mechanisms. Probably the most disastrous result of regarding certain tissues as subserving seeing or hearing *functions* is not that they are misinterpreted, but rather that all the myriads of other conditions which in collocation constitute the seeing or hearing events are overlooked.

Even well authenticated facts can be invalidated by making them into false analogies. We are too prone to take genuine physiological findings as simpler analogies of what happens in complex interbehavioral situations. For example, various physiological phenomena observable in neural preparations such as summation, inhibition or facilitation are taken as simpler correlates of complex interbehavior. As Lashley has excellently said: "Simplified physiological theories of neural integration have hampered the development of psychology and have contributed to a futile sort of psychological atomism.[21] It is false analogizing to expand the proposition that the intactness of the organism is an optimal condition for efficient interbehavior into a description of the total complex interbehaviorial event. To free our-

[19] Lashley, K. S., Mass action in cerebral function, *Science*, 1931, 73, 245-254.

[20] Marquis, D. G., The effects of removal of the visual cortex in mammals, with observation on the retention of light discrimination in dogs, in *Localization of Function in the Cerebral Cortex*, Baltimore, Williams and Wilkins, 1934, Ch. 19.

[21] Op. cit., p. 246.

selves from such misconstruction is not only to save psychology from valuable though misinterpreted physiology, but also to rescue physiology from bad psychology.

Fundamental Interbehavioral Constructions—As we have indicated scientific work may be correctly divided into (a) the handling of events (observing, experimenting) and (b) the construction of hypotheses, protocols, records, descriptions, interpretations and laws. The handling of events inevitably proceeds upon an interbehavioral basis. Not so in the case of constructions. An experimenter may observe the individual's discrimination of light and the subsequent extension of the arm and report that he observed will impulses. Again, he may construct his records and descriptions on the basis of interbehavioral events, but use non-interbehavioral terms. While such a procedure is not so serious it would probably be better so to coordinate the constructions and the events as to leave as little room as possible for misinterpretation.

For this purpose the writer has formulated a series of distinctly interbehavioral constructions which have been used in the present treatise to describe and interpret a large series of psychological events. It is only natural, of course, that with the accumulation of psychological data and their more effective analysis the constructions should be sharpened and refined. Such improvements the writer believes have been made since the original publication of this work in the case of the following important basic constructions.

Behavior segment
- Response (response patterns and reaction systems)
- Stimulus

Interbehavioral media

Interbehavioral setting

Interbehavioral history
- Reactional biography
- Stimulus evolution

Personality

This has been done in my *A Survey of the Science of Psychology* and in other publications.[22]

[22] Concerning physical analogies in psychology, *Am. J. Psychol.*, 1936, 48, 153-164; In defense of stimulus and response psychology. *Psychol. Rev.*, 1933, 40, 324-366.

To these refinements should now be added that whereas I have previously described reactional biography as the complete interbehavioral history, it is probably better to confine the term reactional biography to the organism's side in the event and stress stimulus evolution as the corresponding factor in the interbehavioral history of the ontogenetic development of psychological events.[23]

Also I should like to point out the greater emphasis upon the functional nature of stimulus and response—an emphasis which results from contrasting their place in the interbehavioral framework in which they operate, with the actions of the organisms and objects constituting their vehicles. This contrast can be illustrated by considering that (1) different objects harbor the same (similar) stimulus functions, while (2) the same object harbors different stimulus functions, and (3) that different acts harbor the same response functions, while (4) the same act harbors different response functions.

(1) *Different objects with the same stimulus function*—In a specific situation the behavior segment consists of unit interactions involved in driving a wire brad into a picture frame. The stimulus function corresponding to the particular pounding response may be localized either in a small hammer, pair of pliers or any one of many other sorts of objects.

(2) *Same objects with different stimulus functions*—The same sheet of paper that sometimes stimulates a response of writing down a memorandum or making calculations, at other times harbors stimulus functions correlated with the response of wrapping something in it.

(3) *Different acts carry same response function*—Adding a column of figures up or down illustrates the interrelation of varying acts with the adding stimulus function. Accordingly, these responses, despite their differences, constitute particular response functions in mutual operation with the additional stimulus. Still wider variations of action constituting an identical response are nodding the head or saying yes, when they are mutual operations with the assent stimulus function of a question act.

[23] The phenomenon of stimulus evolution is elaborately treated in my Outline of Social Psychology, Chicago, Follett, 1929.

(4) *Same actions carry different response functions*—Throwing a stone may be interrelated with the stimulus function of the stone which requires to be removed from its present location or with a stimulating action of a threatening dog. In all cases the interacting functions are conditioned by the interbehavioral setting which constitutes the field or framework of a particular behavior segment.

The specification of the inevitable mutuality of stimulus and response functions and the particular field in which they operate fulfills an essential requirement of scientific procedure—namely, paying strict attention to the intimate details of psychological events. The exigencies of psychological analysis more than those of most sciences force upon us an important methodological problem concerning scientific generalization. On the one hand, it is the goal of all science to achieve as comprehensive and rigorous inductions as possible. On the other, we cannot escape the conclusion that in psychology, measurements, calculations and statistical manipulations must, at all costs to rigor and comprehensiveness, keep in close touch with the original data. We believe that the interbehavioral hypothesis meets both these requirements.

It is frequently repeated that science cannot be based upon unique events and that unless phenomena are repetitive they can not be generalized. The view expressed here is derived from work upon the comparatively simple events of classical physics in which minor variations could be neglected and in consequence observations and measurements could be safely averaged. Now the specific details of a psychological event cannot be neglected nor can we overlook the influence of an organism's previous personal history upon any present occurrence. It is a fact, then, that induction as the goal of science can best be served in psychology by taking account of actual occurrences rather than by constructing elaborations and extrapolations which appear so much more definite and manageable than the concrete operation of event factors.

As a matter of actual scientific practice, however, this does not mean that psychology foregoes any inductive powers. It is just as possible to construct generalizations and laws based upon concrete interbehavior as well as upon averages or substitutions. As statistical experts all know, mathematical and calculative manipulations only constitute techniques of handling data after they have been observed and measured. Accordingly, scientific methods demand that phe-

nomena determine the generalizations and not vice versa. The scientific investigator must determine by actual comparisons how closely averages and other calculated indices match the observed events. Competent scientific judgment can be relied upon to discover what differences of this sort are found in various scientific fields.

We submit that in the psychological domain the only valid inductions are those derived from the observation of coincident components in interbehavioral situations. It is the purpose of the entire present treatise to show the necessity for considering the many factors making for the development and performance of interbehavior as the essential conditions and components of psychological events. As the writer has shown elsewhere,[24] it is such interbehavioral situations called behavior segments that make possible a genuine psychological field theory[25] which is autonomous for a particular kind of event and yet correlates with the field theory of physics and other sciences.

[24] Kantor, J. R., Current trends in psychological theory, *Psychol. Bull.*, 1941, 38, 29-65.

[25] The writer is of the opinion that while for specifically psychological purposes the constructional term *behvior segment* is to be preferred to the term *field*, the latter does seem to bring psychological situations into comparative nexus with those of other sciences.